WORKSHOP REFERENCE · 03

Drilling Speeds & Feeds

Starting cutting speeds by ISO material group and a ready-reckoner for spindle speed, so the drill is cutting before the first chip lands.

Cutting speed by material

Vc in m/min · starting values

ISO	Material	Hardness	HSS / HSS-Co	Solid carbide, coated
P	Low-carbon & free-cutting steel	< 180 HB	25–35	100–150
P	Medium-carbon & alloy steel, annealed	180–280 HB	18–25	80–120
P	Alloy & tool steel, hardened & tempered	280–350 HB	10–15	60–90
M	Austenitic stainless (304, 316)	< 200 HB	8–12	40–70
M	Duplex & super-duplex stainless	< 300 HB	6–10	30–50
K	Grey cast iron	< 250 HB	20–30	80–130
K	Ductile (SG) cast iron	< 300 HB	15–25	70–110
N	Wrought aluminium	< 120 HB	60–100	150–300
N	Cast aluminium, high silicon	< 120 HB	40–60	100–200
N	Brass, bronze & copper	< 200 HB	30–60	80–150
S	Titanium alloys	< 350 HB	6–10	25–45
S	Nickel superalloys (Inconel, Hastelloy)	< 350 HB	3–6	15–30
H	Hardened steel	45–55 HRC	—	30–50

Start in the middle of the range. Go lower for long-series drills, poor coolant or unstable set-ups. Through-coolant carbide drills can run at the top of the range.

Feed per revolution in steel

f in mm/rev

Drill Ø mm	HSS	Solid carbide
3	0.04–0.06	0.08–0.12
5	0.07–0.10	0.10–0.15
8	0.10–0.15	0.15–0.22
10	0.12–0.18	0.18–0.25
12	0.15–0.20	0.20–0.28
16	0.18–0.25	0.25–0.32
20	0.22–0.30	0.28–0.36

Stainless and titanium: about 70% of these feeds. Aluminium and brass: up to 130%. Peck when depth exceeds 3 × D with HSS.

Formulas

Spindle speed $n = Vc \times 1000 \div (\pi \times D)$
Cutting speed $Vc = \pi \times D \times n \div 1000$
Feed rate $vf = f \times n$ (mm/min)
Milling feed $vf = fz \times z \times n$

n spindle speed (RPM)
Vc cutting speed (m/min)
D tool diameter (mm)
f feed per revolution (mm/rev)
fz feed per tooth (mm) · z number of teeth

Spindle speed (RPM) by drill diameter and cutting speed

n = Vc × 1000 ÷ (π × D)

Drill Ø mm	5	10	15	20	25	30	40	50	60	80	100	120	150	200	250	300
	Cutting speed Vc (m/min) →															
1	1,590	3,200	4,750	6,350	7,950	9,550	12,700	15,900	19,100	25,500	31,800	38,200	47,700	63,700	79,600	95,500
1.5	1,060	2,100	3,200	4,250	5,300	6,350	8,500	10,600	12,700	17,000	21,200	25,500	31,800	42,400	53,100	63,700
2	800	1,590	2,400	3,200	4,000	4,750	6,350	7,950	9,550	12,700	15,900	19,100	23,900	31,800	39,800	47,700
2.5	640	1,270	1,910	2,550	3,200	3,800	5,100	6,350	7,650	10,200	12,700	15,300	19,100	25,500	31,800	38,200
3	530	1,060	1,590	2,100	2,650	3,200	4,250	5,300	6,350	8,500	10,600	12,700	15,900	21,200	26,500	31,800
3.3	480	960	1,450	1,930	2,400	2,900	3,850	4,800	5,800	7,700	9,650	11,600	14,500	19,300	24,100	28,900
4	400	800	1,190	1,590	1,990	2,400	3,200	4,000	4,750	6,350	7,950	9,550	11,900	15,900	19,900	23,900
4.2	380	760	1,140	1,520	1,890	2,250	3,050	3,800	4,550	6,050	7,600	9,100	11,400	15,200	18,900	22,700
5	320	640	950	1,270	1,590	1,910	2,550	3,200	3,800	5,100	6,350	7,650	9,550	12,700	15,900	19,100
6	270	530	800	1,060	1,330	1,590	2,100	2,650	3,200	4,250	5,300	6,350	7,950	10,600	13,300	15,900
6.8	230	470	700	940	1,170	1,400	1,870	2,350	2,800	3,750	4,700	5,600	7,000	9,350	11,700	14,000
8	200	400	600	800	990	1,190	1,590	1,990	2,400	3,200	4,000	4,750	5,950	7,950	9,950	11,900
8.5	190	370	560	750	940	1,120	1,500	1,870	2,250	3,000	3,750	4,500	5,600	7,500	9,350	11,200
10	160	320	480	640	800	950	1,270	1,590	1,910	2,550	3,200	3,800	4,750	6,350	7,950	9,550
10.2	160	310	470	620	780	940	1,250	1,560	1,870	2,500	3,100	3,750	4,700	6,250	7,800	9,350
12	130	270	400	530	660	800	1,060	1,330	1,590	2,100	2,650	3,200	4,000	5,300	6,650	7,950
14	110	230	340	450	570	680	910	1,140	1,360	1,820	2,250	2,750	3,400	4,550	5,700	6,800
16	100	200	300	400	500	600	800	990	1,190	1,590	1,990	2,400	3,000	4,000	4,950	5,950
17.5	90	180	270	360	450	550	730	910	1,090	1,460	1,820	2,200	2,750	3,650	4,550	5,450
20	80	160	240	320	400	480	640	800	950	1,270	1,590	1,910	2,400	3,200	4,000	4,750
22	70	140	220	290	360	430	580	720	870	1,160	1,450	1,740	2,150	2,900	3,600	4,350
25	60	130	190	250	320	380	510	640	760	1,020	1,270	1,530	1,910	2,550	3,200	3,800
28	60	110	170	230	280	340	450	570	680	910	1,140	1,360	1,710	2,250	2,850	3,400
32	50	100	150	200	250	300	400	500	600	800	990	1,190	1,490	1,990	2,500	3,000

Rounded to the nearest 10 RPM (50 above 2,000 and 100 above 10,000). Speeds above 20,000 RPM are greyed out. The same table works for end mills and reamers.

Reference values compiled from the cited standards and published manufacturer data. Always confirm against the tool maker's recommendations for your machine, tool and set-up.